



HEXAPODAL UNMANNED GUIDED VEHICLE FOR DEFENCE

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ABSTRACT

The most eminent problems world is facing today are terrorism and revolt. With growing technology better lookout systems and security systems developed. We aim to establish "Unmanned Ground Vehicle" to perform duties like surveillance & border patrol. It is the prototype to clarify need for sophisticated technology and vehicles in defense. A human operator from a base station can control motion of UGV wirelessly. These systems have two units' motion tracking unit and control unit. For tracking motion, it uses image processing techniques. The base station control computer allows the remote user to see live video stream and control various UGV features using graphical user interface.

KEYWORDS: Unmanned Ground Vehicle (UGV), R-Hex, Localization, Image processing, Vertex identification.

I. INTRODUCTION

An Unmanned Ground Vehicle (UGV) is a vehicle in which there is no human operator present in it. This type of robots can be tele operated or autonomous. The tele operated UGV's are cheaper and they are simpler than autonomous and also easy to control. To access all information about current status in every moment motion planning is required and is very easier to implement. Therefore, remotely controlled UGV's are practically suitable for system where vehicles operate within same structural space such as border, industries, etc.

An Unmanned Ground Vehicle (UGV) [1] is a robot used in military to accumulate the soldier's capability. This type of robot is generally capable of functioning in place of humans. The unmanned robotics is developed actively for military use to carry out dull, dirty, dangerous activities. There are two general classes of Unmanned Ground Vehicles.

1. Tele operated
2. Autonomous

A. Tele operated

A tele-operated UGV is a vehicle which is controlled by a human operator at a base station via a communication link either wired or wireless. All intellectual processes are administering by the operator based upon sensory feedback from either remote sensory inputs such as video cameras or line-of-sight visual observation.

B. Autonomous

In this mode, vehicle itself logically performs the operations without human interference.

II. R-HEX

The R-Hex concept [2] is a six-legged robot with intrinsically high flexibility. Dynamic, independently controlled legs produce specialized carriage that go through rough surface with basic operator input. R-Hex rise in rock fields, sand, mud, telephone poles, flora, railroad tracks and up slopes. R-Hex has a sealed body, making it fully operational in misty weather, muddy and marshy conditions. R-Hex can be controlled remotely from an operator control unit.

The R-Hex is the latest version of highly mobile R-Hex platform. The R-Hex design for greater durability, longer runtime and more flexibility than previous versions.

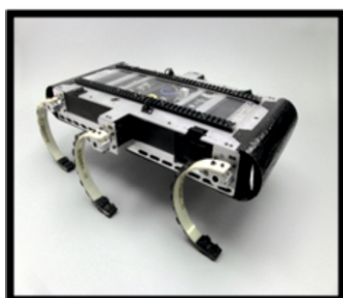


Figure.1. R-Hex

III. LOCALIZATION SYSTEM

Localization system consist of orientation and determining the position. Therefore, it is also known as pose estimation of UGV.

Localization can be performed by placing on-board system on UGV'S. sometimes, GPS is also used for outdoor environments but it has some limitations such as it does not have good accuracy and the main limitation is it does not work in indoor environments. The hybrid (indoor as well as outdoor) solution proposed in [3]. Ultrasonic transmitters and receivers are used to determine the position of UGV by measuring ultrasonic distance. for robot localization the RFID readers and RFID tags are used. These tags are detected by RFID reader. [4] [5] This solution also has limitation of less accuracy.

Off-board system can also be used for localization. These systems are implemented outside the UGV'S. This is done by placing devices such as cameras at predefined positions in the environment. This system is cost effective and consumes less power of UGV. In this paper we are using visual and off-board localization system which has advantages of both.

IV. ARCHITECTURAL DESIGN

A. System Block Diagram

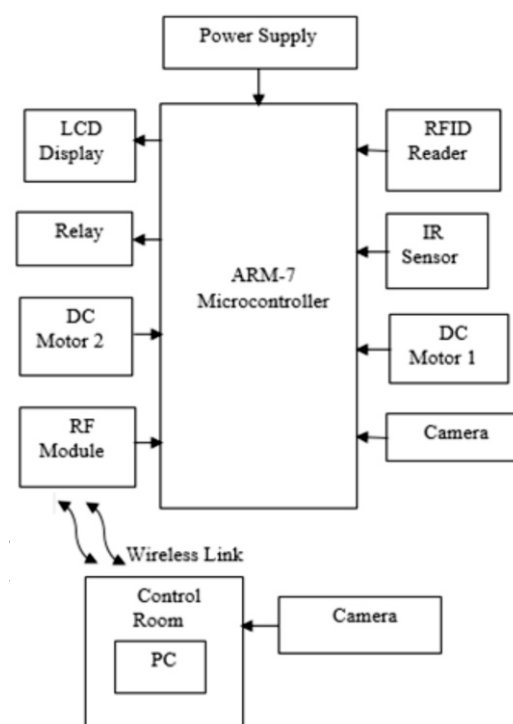


Figure.2. Block Diagram of System

The block diagram of UGV system consists of following sections as shown in fig.2.

1. ARM-7 Microcontroller
2. RF Module
3. RFID Reader
4. IR Sensor
5. DC Motor
6. LCD Display
7. Camera

V. PROPOSED SYSTEM IMPLEMENTATION

The block diagram of the proposed system is as shown in fig.2.

Each distributed unit consist of camera which shows the actual position of UGV. For the pose estimation UGVs use isosceles triangles which has red colour and they are attached to white plates located on top of UGVs as shown in fig.3. [6]

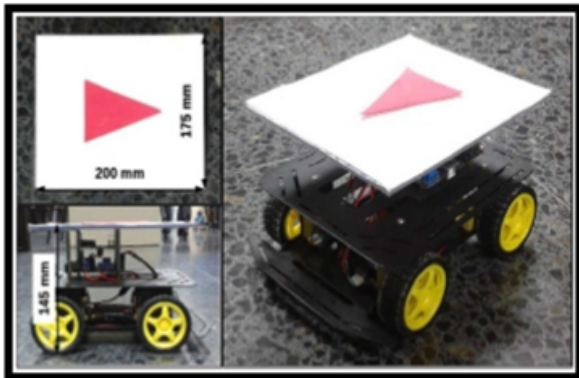


Fig.3. UGV marked with isosceles triangle.

To make pose estimation to be greatly simplified the use of isosceles triangles is very effective. Because the shape contains all required information about orientation and UGV position. Due to the high contrast between colours of marker and supporting plate simplify the detection of UGV in environment.

And by using image processing techniques we can provide path to UGV by making use of graphical user interface.

The image processing techniques used in proposed system mainly performs following tasks that are:

1. Image capture and vertex identification
2. Shape reconstruction and pose estimation
3. Image correction and vertex projection

A. Image Capture and vertex identification

Each image processing node is reliable for conformation of the connected camera, mainly in terms of image resolution, exposure time and pixel depth etc. after the initial conformation data fusion controller can capture the new image at the maximum possible rate. Image capture rate is depending on the conformation of camera.

The identification of distinct colours of markers can be done through comparison with the lower and upper threshold value of component. Binarization steps are used to carry out comparison after each pixel in captured image is represented in single bit such as "0" or "1". To preserve only pixels and eliminate noise erosion is applied to the binarized image. The determination of vertices can be done by identifying the pixels of shape with minimum and maximum column and row values as shown in fig.4. [6]

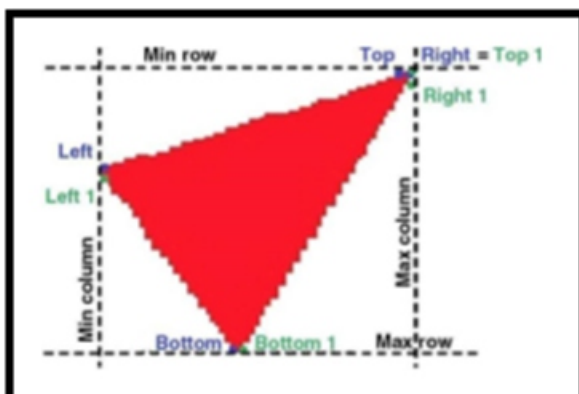


Fig.4. Concept of vertex identification.

B. Shape reconstruction and pose estimation

UGVs can move the viewing area of the different cameras. Therefore, the system is most capable to perfectly limited in such cases if one possible solution is to be given if the camera is placed on the UGV. because of the viewing the size of whole UGV and the overlapping area. if using one camera it can easily identify the position of UGV can be placed on the targeted place. This is the main advantage of viewing the area and to simplify the establishment foundation of the system.

The data fusion controller can synchronize the image processing node it can capture the image at same time. The shape reconstruction is the important concept for the when shape is accurately performing whenever the UGV can comparatively send from the fusion controller to all image processing node it can introduce the new capture image.

C. Image correction and vertex projection

Because of the optical lens effect, the distorted version of image is provided by the camera as compare to the actual image, where the geometry different from the reality. Is to be corrected and accurate measurement is obtained from images. The particular application, the fault is to be accurate is the barrel distortion, if the radial type of distortion which can occur the magnification of lens is decreases with the distance from the optical axis, that causes each image point to move radially towards the centre of image. The main effect is that the actual straight line is curved in the image.

VI. RESULTS AND DISCUSSIONS

The movement and position of UGV is based on their angle. The angle and respective directions which are given to UGV are as shown in fig.5.

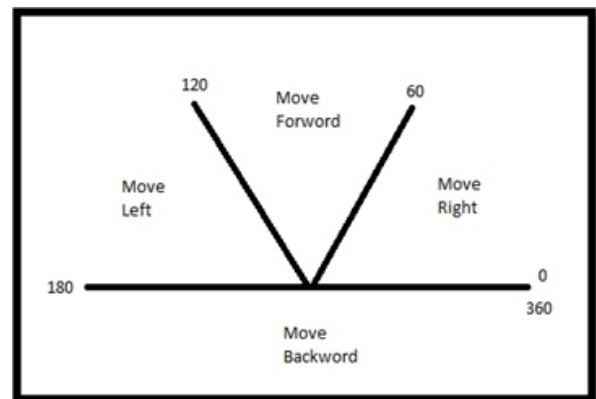


Fig.5. Movement of UGV with Respect to Angle

The results of UGV movement are presented in tabular form in table.1.

Table.1. UGV Movement

Case	1	2	3	4
Angle	0-60	70-120	130-180	190-360
Orientation Performed	Right	Forward	Left	Backward

Here case 1 indicates angle is in between 0-60 at that time UGV will move towards right. When case 2 occurs angle is in between 70-120 and UGV will move in forward direction. Similarly, for case three it will move toward left direction and for remaining angles it will move in backward direction. All these operations of UGV are controlled by sending commands by human operator.

VII. CONCLUSION

The various technologies in combination help us to achieve goals which have been never achieved in past. Being use of these technologies we bring a machine which is able to handle situations which makes humans job easier in present day.

REFERENCES

- [1] Unmanned Ground Vehicle (UG Thesis), Mithileysh Sathiyarayanan, Department of Electronics and Communication, Rajiv Gandhi Institute of Technology, Cholanagar, Hebbal, Bengaluru- 560032, August 2016.
- [2] Terrain Identification for R-Hex Type Robots, Camilo Ordóñez, Jacob Shill, Aaron Johnson, Jonathan Clark and Emmanuel Coll Mechanical Engineering, Florida State University, Tallahassee, FL 31310, USA; Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, PA 19104, USA, 2013.
- [3] S. Kim and K. Byung Kook, "Dynamic ultrasonic hybrid localization system for indoor mobile robots," IEEE Trans. Ind. Electron., vol. 60, no. 10, pp. 4562-4573, Oct. 2013.
- [4] L. Catarinucci, S. Tedesco, and L. Tarricone, "Customized ultra-high frequency radio frequency identification tags and reader antennas enabling reliable mobile robot navigation," IEEE Sensors J., vol.13, no. 2, pp. 783-791, Feb. 2013.
- [5] E. Di Giampaolo and F. Martinelli, "A passive UHF-RFID system for the localization of an indoor autonomous vehicle," IEEE Trans. Ind. Electron., vol. 59, no. 10, pp. 3961-3970, Oct. 2012.

- [6] Design Field-Programmable System-On-Chip for Localization of UGVs in an Indoor Space Jorge Rodríguez-Araújo, Juan J. Rodríguez-Andina, Senior Member, IEEE, José Fariña, Member, IEEE, and Mo-Yuen Chow, Fellow, IEEE, IEEE Transactions on Industries Informatics, vol. 10, no. 2, may 2015.